British Journal of Cancer (2012) 107, 201–206

www.bjcancer.com

Men with cancer change their health behaviour: a prospective study from the Danish Diet, Cancer and Health Study

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BACKGROUND: Health behaviour changes may improve the quality of life and survival among cancer survivors. We prospectively examined changes in health behaviour among and between men with prostate cancer (PC), men with cancers other than PC and cancer-free men.

METHODS: We analysed data for 20 914 men (50–65 years), 426 with cancer, and 20 488 persons who were cancer-free between baseline (1993–1997) and follow-up (2000–2002) in multiple linear regression models to determine differences in changes in body mass index (BMI) and in alcohol and tobacco consumption.

RESULTS Body mass index and tobacco and alcohol consumption decreased significantly ($P<0.001$) between baseline and follow-up among both men with cancer and cancer-free men. Men with cancers other than PC significantly decreased their BMI ($\beta = -058$; 95% confidence interval (CI): -0.77, -0.40) and tobacco consumption ($\beta = -1.36$; 95% CI: -2.22, -0.49) compared with cancer-free men and were significantly more likely to quit smoking and lose weight.

CONCLUSION: Men with cancers other than PC decreased their tobacco consumption and BMI significantly more than cancer-free men. Men with cancer do change their health behaviour; clinicians should take this into account in planning follow-up care for cancer survivors.

British Journal of Cancer (2012) **107,** 201–206. doi:10.1038/bjc.2012.238 www.bjcancer.com
Published online 29 May 2012

Keywords: health behaviour; lifestyle; men

Behaviour such as smoking, alcohol consumption, physical inactivity and high body mass index (BMI) are associated with increased risks for cancer (Demark-Wahnefried *et al*, 2008; Khan *et al*, 2010). The increasing number of cancer survivors (~11.4 million persons with a history of cancer were alive in the United States in 2006: American Cancer Society, 2010) has prompted studies of the effect of behaviour on both survival and also quality of life after treatment for cancer (Demark-Wahnefried *et al*, 2005; Blanchard *et al*, 2008; Demark-Wahnefried and Jones, 2008; Gritz and Demark-Wahnefried, 2009). Some studies have suggested that a cancer diagnosis may present a teachable moment for changes in health behaviour (Demark-Wahnefried *et al*, 2000, 2005; Pinto *et al*, 2000). Health behaviour can affect the risk for recurrence, second cancers and other chronic diseases, such as cardiovascular disease, diabetes and obesity (Aziz, 2002; Demark-Wahnefried *et al*, 2005). Furthermore, sociodemographic factors such as age, marital status and education may affect health behaviour (Demark-Wahnefried *et al*, 2000, 2005; Umberson *et al*, 2010). A clear understanding of these complex associations is needed in order to identify the changes in health behaviour that could improve the survival and quality of life of cancer patients (Aziz, 2002; Demark-Wahnefried *et al*, 2005; Blanchard *et al*, 2008; Gritz and Demark-Wahnefried, 2009).

Comparisons of the health behaviour of cancer survivors and cancer-free persons have shown only small differences in levels of smoking, physical activity, diet and BMI (Bellizzi *et al*, 2005; Coups and Ostroff, 2005; Eakin *et al*, 2007; Mayer *et al*, 2007). Most of these studies had, however, methodological limitations, such as a cross-sectional design, self-reported cancer diagnosis and health behaviour known to be subject to recall bias. We found only one prospective study in which the health behaviour of women with breast or colon cancer was compared with that of cancer-free women, which showed little change towards compliance with cancer prevention guidelines (Skeie *et al*, 2009). No studies have been conducted on health behaviour changes after a cancer diagnosis only among men, even though men engage in more risky behaviour, including smoking and drinking (Courtenay, 2000; Oksuzyan *et al*, 2008) and may be less likely to change their behaviour or to maintain any changes (Patterson *et al*, 2003; Demark-Wahnefried *et al*, 2005; Mosher *et al*, 2009).

We conducted a prospective study to compare differences in changes in BMI and alcohol and tobacco consumption among men with and without cancer. As different cancers and their treatment may influence health behaviour differently (Gritz *et al*, 1991; Ostroff *et al*, 1995; Demark-Wahnefried *et al*, 2005), we evaluated behaviour changes separately for the homogeneous group of men with prostate cancer (PC) and the combined group of men with other cancers. We hypothesised, that men with cancer would not change their health behaviour significantly compared with cancer-free men to comply with the recommendations of the Danish National Health Board (www.sst.dk) with regard to alcohol consumption (three drinks per day; one drink = 12 g alcohol), BMI ($>18.5\,kg\,m^{-2}$ $<25\,kg\,m^{-2}$), and use of tobacco (non-smokers) when adjusting for age, educational and marital status as potential confounders.

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Received 27 January 2012; revised 16 April 2012; accepted 25 April 2012; published online 29 May 2012

MATERIALS AND METHODS

Study population

We used data from the Diet Cancer and Health Study, for which a cohort was established prospectively to evaluate the aetiological role of diet in cancer risk. The cohort consisted of persons identified in the Civil Population Register, in which all Danish residents have been registered since 1968 and assigned a unique 10-digit personal identification number, which ensures accurate linkage with all national registries (Pedersen *et al*, 2006). A detailed description of the cohort has been published elsewhere (Tjonneland *et al*, 2007). In brief, between December 1993 and May 1997, all individuals (80 996 men and 79 729 women) living in greater Copenhagen and the Aarhus area and who fulfilled the inclusion criteria were invited to participate. Baseline and follow-up questionnaires were sent from and returned to the Institute of Cancer Epidemiology, Department of Diet Cancer and Health. Two reminders were sent at both assessment times to non-responders. Participants went to one of the two study centres (in Copenhagen and Aarhus), where trained professionals measured their height and weight and calculated their BMI at baseline. The invitation was accepted by 57 053 persons, of whom 27 179 were men (33.5% of those invited), and all the participants filled in a self-administered baseline questionnaire eliciting information on sociodemographic factors and health behaviour. In 2000–2002, a follow-up survey of all 54 379 eligible cohort participants was conducted, and 45 298 (83.3% of those responding at baseline) filled in a follow-up questionnaire; of these, 21 071 were men. Participants for whom information on health behaviour was missing were excluded from the relevant analysis.

Information on cancer status

Since 1943, all cases of cancer in Denmark have been registered in the Danish Cancer Registry and classified according to a modified Danish version of the International Classification of Disease, 7th revision (Storm *et al*, 1997). By linkage with the Danish Cancer Registry, we identified 453 men who had received a diagnosis of cancer (excluding non-melanoma skin cancer) in the period between baseline and follow-up. Men with secondary or unspecified cancers ($n=25$) and men for whom information on education and marital status was missing ($n=132$) were excluded, leaving 20 914 men, of whom 426 received a diagnosis of cancer: head and neck ($n=37$), upper gastrointestinal ($n=21$), lung ($n=20$), malignant melanoma ($n=51$), prostate ($n=129$), colorectal ($n=82$), urinary and bladder ($n=29$), leukaemia or lymphoma ($n=28$) and other ($n=29$).

Information on education and marital status

Information on educational status (basic or high school, vocational training and higher education) was obtained from the baseline questionnaire. Information on marital status at baseline (never married, divorced or widowed, married or with a registered partner) and vital status (alive or dead) was obtained from the Civil Population Register.

Information on health behaviour

At both baseline and follow-up, participants were asked to indicate how much they smoked per day in terms of cigarettes (1 g tobacco/cigarette), cigars (4.5 g tobacco/cigar), cheroots (3 g tobacco/cheroot) and pipes (3 g tobacco/pipe), and these were summed as grams of tobacco per day. Alcohol was also measured as grams per day, one drink corresponding to 12 g of alcohol. At baseline, participants were asked to indicate how often and how much they drank of each of the following types of alcohol: light beer (8.9 g alcohol/bottle), ordinary beer (12.2 g alcohol/bottle), strong beer (17.5 g alcohol/bottle), wine (12.2 g alcohol/glass), fortified wine (9.3 g alcohol/unit) and liquor (9.9 g alcohol/unit). The following categories were used: never, <1 per month, 1 per month, 2–3 per month, 1 per week, 2–4 per week, 5–6 per week, 1 per day, 2–3 per day, 4–5 per day, 6–7 per day, $\geqslant 8$ per day. At follow-up, separate items were included for red wine *vs* white and rosé wine, and the categories were slightly different: never or rarely, 1 per month, 2–3 per month, 1–2 per week, 3–4 per week, 5–6 per week, 1 per day, 2–3 per day, 4–5 per day, 6–7 per day, $\geqslant 8$ per day. The baseline alcohol consumption categories 'never' and '<1 per month' were combined for the analyses. We used BMI as an indicator of overweight and the underlying health behaviour with regard to a balanced calorie intake and physical activity. At baseline, weight and height were measured by trained professionals, and BMI was calculated as (weight (kg)/(height (m)^2). At follow-up, weight was self-reported.

Statistical analysis

Descriptive analyses were conducted of demographic factors, mean tobacco and alcohol consumption and BMI at baseline and follow-up for men with cancers other than PC, men with PC and cancer-free men. χ^2 tests were used to test the difference in health behaviour changes (categorical) between baseline and follow-up. Multiple linear regression models with 95% confidence intervals (CIs) were used to examine differences in health behaviour changes (BMI, tobacco and alcohol consumption as continuous variables) from baseline to follow-up between men with cancers other than PC and cancer-free men and between men with PC and cancer-free men. The analyses included adjustment for age at baseline and baseline values for the health behaviour in question.

As the estimates of differences in smoking, alcohol intake and BMI did not follow a normal distribution, we conducted non-parametric analyses (Wilcoxon). The results varied only minimally from those of the parametric tests, and we present here only the results of the parametric tests, which allow precise estimates of differences.

Separate analyses were conducted for men with a diagnosis less than and more than 2 years before the follow-up measurement. Separate analyses in multiple logistic regression models were also conducted for men who quit smoking, decreased their BMI from overweight ($\geqslant 25\,\mathrm{kg\,m^{-2}}$) to normal ($<25\,\mathrm{kg\,m^{-2}}$) or decreased their alcohol consumption from >3 to <3 drinks per day between baseline and follow-up.

The GLM and Genmod procedure in the SAS statistical software package release 9.1 (SAS Institute, Inc., Cary, NC, USA) was used for the statistical analyses.

RESULTS

The mean age of the 20 914 men at entry into the study was 56.6 years (range, 50.1–65.6 years). The mean ages of men with cancers other than PC and men with PC were slightly higher than that of cancer-free men (58.2 *vs* 59.6 *vs* 56.5) (Table 1). More cancer-free men than men with cancers other than PC had higher education (25% *vs* 21%), while no group differences were seen with regard to marital status. Among men with cancers other than PC, 44% were current smokers, 36% took more than three drinks a day (36 g alcohol) and 62% were overweight (BMI $\geqslant 25$) at baseline. Tobacco and alcohol consumption and BMI decreased significantly between baseline and follow-up in all three groups (Table 1).

Men with cancers other than PC decreased their tobacco consumption ($\beta=-1.36$ g per day; 95% CI: -2.22, -0.49) and BMI ($\beta=-0.58\,\mathrm{kg\,m^{-2}}$; 95% CI: -0.77, -0.40) significantly more than the cancer-free men, whereas men with PC had a small

Epidemiology

Table 1 Demographic characteristics and comparison of health behaviours within groups at baseline and follow-up according to cancer status among 20 914 Danish men in the Diet, Cancer and Health Study

	Men with cancer N = 426		Men with cancer other than PC N = 297		Men with PC N = 129		Cancer-free men N = 20 488	
	Baseline	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**	**Baseline**	**Follow-up**
Age at baseline								
Range	50.3–65.4	53.6–71.1	50.3–65.4	55.5–71.1	50.5–65.2	53.6–69.9	50.1–65.6	54.3–72.5
Mean (s.d.)	58.6 (4.3)	63.4 (4.2)	58.2 (4.3)	63.5 (4.3)	59.6 (4.1)	63.0 (4.1)	56.5 (4.3)	61.9 (4.3)
Education (N (%))								
Basic or high school	161 (38)		112 (38)		49 (38)		6788 (33)	
Vocational training	176 (41)		124 (42)		52 (40)		8623 (42)	
Higher education	89 (21)		61 (21)		28 (22)		5077 (25)	
Marital status (N (%))								
Never married	19 (4)		15 (5)		4 (3)		1104 (5)	
Divorced/widowed	59 (14)		46 (15)		13 (10)		3012 (15)	
Married/registered partner	348 (82)		236 (79)		112 (86)		16 372 (80)	
Health behaviour								
Tobacco g/day (N (%))								
Mean	9.1	5.3[a]	9.3	5.5[b]	7.8	5.0[c]	7.3[d]	5.3[e]
0	248 (58)	299 (73)	167 (56)	204 (72)	81 (63)	95 (77)	12 954 (63)	14 074 (72)
1–10	35 (8)	21 (5)	22 (7)	16 (6)	13 (10)	5 (4)	1628 (8)	1357 (7)
11–20	77 (18)	45 (11)	55 (18)	32 (11)	22 (17)	13 (10)	3320 (16)	2373 (12)
⩾20	66 (15)	40 (10)	53 (18)	30 (11)	13 (10)	10 (8)	2567 (13)	1715 (9)
	P-value <0.001		*P*-value <0.001		*P*-value <0.001		*P*-value <0.001	
Alcohol g/day (%)								
Mean	30.1	28.1	32.1	30.1	25.6	23.4	27.0[f]	27.2
0	14 (3)	16 (4)	9 (3)	9 (3)	5 (4)	7 (5)	459 (2)	503 (2)
1–36	269 (63)	269 (63)	180 (61)	177 (60)	89 (69)	92 (71)	14 147 (69)	14 153 (69)
>36	143 (34)	141 (33)	108 (36)	111 (37)	35 (27)	30 (23)	5872 (29)	5832 (28)
	P-value <0.001		*P*-value <0.001				*P*-value <0.001	
BMI (%)								
Mean	26.4[g]	26.0[h]	26.5[i]	25.8[j]	26.1	26.3[k]	26.5[l]	26.4[m]
<18.5	0 (0)	2 (0)	0 (0)	2 (0)	0 (0)	0 (0)	38 (0)	50 (0)
18.5–24.9	157 (37)	175 (41)	115 (39)	136 (46)	42 (33)	39 (30)	7029 (34)	7121 (35)
25–29.9	202 (48)	184 (43)	132 (45)	112 (38)	70 (54)	72 (56)	10 461 (51)	10 360 (51)
⩾30	66 (15)	63 (15)	49 (17)	46 (16)	17 (13)	17 (13)	2949 (14)	2903 (14)
	P-value <0.001		*P*-value <0.001		*P*-value <0.001		*P*-value <0.001	

Abbreviations: BMI = body mass index; PC = prostate cancer. [a]Information missing for 21. [b]Information missing for 15. [c]Information missing for 6. [d]Information missing for 19. [e]Information missing for 969. [f]Information missing for 10. [g]Information missing for 1. [h]Information missing for 2. [i]Information missing for 1. [j]Information missing for 2. [k]Information missing for 1. [l]Information missing for 11. [m]Information missing for 54. All numbers, proportions and means for baseline and follow-up are based on people with no missing information at either time.

but significant increase in BMI ($\beta = 0.28\,kg\,m^{-2}$; 95% CI: 0.00, 0.55) as compared with cancer-free men (Table 2).

Among men who were smokers at baseline, men with cancers other than PC were significantly more likely to quit smoking than cancer-free men. Thus, 59% of smokers with cancers other than PC and 31% of cancer-free smokers quit smoking. Among men who were overweight at baseline, men with cancers other than PC were significantly more likely to decrease their BMI to normal than were cancer-free men, with a change in 13% of men with cancers other than PC and 7% in cancer-free men. Men with cancers other than PC who took more than three drinks per day at baseline were significantly less likely to decrease their alcohol consumption than cancer-free men (Table 3).

The mean time since diagnosis was 2.2 years (range, 0.01–5.51) for men with cancers other than PC and 2.0 years (range, 0.01–5.29) for those with PC. Among men who received their diagnosis within 2 years of follow-up, those with cancers other than PC had decreased their BMI ($\beta = -0.89\,kg\,m^{-2}$; 95% CI: -1.14, -0.63) and tobacco use ($\beta = -1.32$ g per day; 95% CI: -2.52, -0.12), but not their alcohol consumption, significantly more than cancer-free men. Men with cancers other than PC diagnosed >2 years before the follow-up measurement had decreased their tobacco consumption significantly more than cancer-free men ($\beta = -1.41$ g per day; 95% CI: -2.65, -0.17), but not their alcohol consumption or BMI (data not shown).

DISCUSSION

Men irrespective of a cancer diagnosis, over time changed their health behaviour to comply with the recommendations of the Danish National Board of Health. Positive changes in regard to smoking and BMI appeared to be confined to the group of men with cancers other than PC, who were more likely to quit smoking and lose weight. We found no significant difference in positive health behaviour changes between men with PC and cancer-free men.

These findings confirm the assumption that cancer and its treatment influence health behaviour differently. Treatment for PC

Epidemiology

Table 2 Multiple linear regression models for differences in change in health behaviour among men with cancer and cancer-free, men with cancer other than PC and cancer-free men, and men with PC and cancer-free men in the Diet, Cancer and Health Study

	Men with cancer ($N=426$) and cancer-free men ($N=20\,488$) B[a] (95% CI)			Men with cancer other than PC ($N=297$) and cancer-free men ($N=20\,488$) B[a] (95% CI)			Men with PC ($N=129$) and cancer-free men ($N=20\,488$) B[a] (95% CI)		
Characteristic	**Smoking (g per day) $N=19\,906$**	**Alcohol intake (g per day) $N=20\,904$**	**BMI (kg m^{-2}) $N=20\,858$**	**Smoking (g per day) $N=19\,783$**	**Alcohol intake (g per day) $N=20\,775$**	**BMI (kg m^{-2}) $N=20\,730$**	**Smoking (g per day) $N=19\,624$**	**Alcohol intake (g per day) $N=20\,607$**	**BMI (kg m^{-2}) $N=20\,562$**
Cancer									
No	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Yes	−1.05 (−1.77, −0.32)	NS	−0.33 (−0.48, −0.17)	−1.36 (−2.22, −0.49)	NS	−0.58 (−0.77, −0.40)	NS	NS	0.28 (0.00, 0.55)
Education									
Basic/high school	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Vocational training	−0.44 (−0.68, −0.20)	1.63 (1.02, 2.22)	−0.17 (−0.22, −0.12)	−0.43 (−0.67, −0.18)	1.62 (1.01, 2.22)	−0.17 (−0.22, −0.12)	−0.42 (−0.66, −0.18)	1.63 (1.03, 2.24)	−0.17 (−0.22, −0.11)
Higher education	−0.43 (−0.70, −0.15)	2.82 (2.13, 3.51)	−0.27 (−0.33, −0.21)	−0.42 (−0.70, −0.15)	2.80 (2.11, 3.49)	−0.27 (−0.33, −0.21)	−0.40 (−0.68, −0.13)	2.88 (2.19, 3.57)	−0.27 (−0.33, −0.21)
Marital status									
Never married	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference
Divorced/widowed	NS	2.10 (0.81, 3.40)	NS	NS	2.07 (0.77, 3.04)	NS	NS	2.14 (0.83, 3.44)	NS
With partner	NS	1.91 (0.76, 3.06)	NS	−0.55 (−1.01, −0.09)	1. 89 (0.74, 3.04)	NS	−0.57 (−1.03, −0.11)	1.90 (0.75, 3.06)	NS

Abbreviations: NS = non-significant; BMI = body mass index; PC = prostate cancer; CI = confidence interval. Improvement indicates decreased tobacco or alcohol consumption or BMI. [a]β Coefficients reflect the change in health behaviour for each decrement in the independent variable. Analyses are mutually adjusted and adjusted for age at baseline. Decrease in health behaviour is represented by (−).

Table 3 Multiple logistic regression models of differences in health behaviour change among men with and without cancer in a subgroup of men who quit smoking, decreased alcohol consumption to <3 drinks per day or decreased BMI from overweight to normal weight from baseline to follow-up in the Diet, Cancer and Health Study

	Men with cancer other than PC and cancer-free men, OR (95%)			Men with PC and cancer-free men, OR (95%)		
Characteristic	**Smoking $N=6767$**	**Alcohol $N=5980$**	**BMI $N=13\,560$**	**Smoking $N=6692$**	**Alcohol $N=5907$**	**BMI $N=13\,465$**
Cancer						
No	Reference	Reference	Reference	Reference	Reference	Reference
Yes	1.82 (1.24–2.65)	0.58 (0.45–0.97)	2.08 (1.41–3.05)	NS	NS	NS
Education						
Basic or high school	Reference	Reference	Reference	Reference	Reference	Reference
Vocational training	NS	0.77 (0.68–0.88)	1.38 (1.20–1.58)	NS	1.30 (1.14–1.47)	0.74 (0.64–0.85)
Higher education	NS	0.64 (0.56–0.74)	1.79 (1.54–2.08)	NS	1.57 (1.36–1.81)	0.55 (0.48–0.65)
Marital status						
Never married	Reference	Reference	Reference	Reference	Reference	Reference
Divorced or widowed	NS	NS	NS	NS	NS	NS
With partner	1.36 (1.06–1.74)	NS	NS	0.72 (0.56–0.93)	NS	NS

Abbreviations: BMI = body mass index; NS = non-significant; OR = odds ratio; PC = prostate cancer. Analyses are mutually adjusted and adjusted for age at baseline.

may have a less severe impact on general health and may therefore not induce changes in health behaviour. Furthermore, the change in BMI among men with cancers other than PC might have been due to progression of cancer or its treatment.

We also found positive changes in health behaviour among cancer-free men, perhaps due to national campaigns recommending changes in health behaviour associated with lifestyle diseases like cancer, diabetes and cardiovascular disease (Khan *et al*, 2010). Participation in the Diet Cancer and Health study might also have increased awareness about health behaviour; however, this would apply to men with and without cancer.

The results of this study are in line with those of population-based surveys that showed only small differences in the health behaviour of cancer survivors and cancer-free persons (Bellizzi *et al*, 2005; Coups and Ostroff, 2005; Eakin *et al*, 2007; Mayer *et al*, 2007).

We found no significant difference in alcohol consumption between men with cancers other than PC and cancer-free men; however, men with cancers other than PC were significantly less likely to decrease their alcohol consumption from more than to fewer than three drinks a day. Also, in contrast to previous studies (Bellizzi *et al*, 2005; Coups and Ostroff, 2005), we found more heavy drinkers among men with cancers other than PC than among cancer-free men.

Even though we found that men with cancers other than PC significantly decreased their tobacco consumption, the number of current smokers at follow-up was similar to that among cancer-free men and in accordance with survey studies (Coups and Ostroff, 2005; Mayer *et al*, 2007). The baseline levels of tobacco consumption were higher in men with cancers other than PC and then decreased to levels similar to those of cancer-free men.

We did not confirm the previous finding of a higher prevalence of overweight (BMI $\geqslant 25\,kg\,m^{-2}$) among cancer patients than cancer-free persons seen in previous studies (Coups and Ostroff, 2005; Eakin *et al*, 2007; Mayer *et al*, 2007). A comparison of men with PC and cancer-free men, however, showed a significantly greater increase in BMI among men with PC. This might have been a result of hormonal therapy, with which weight gain is a well-documented adverse event (Kumar *et al*, 2005).

Sociodemographic factors such as educational level have been suggested to influence tobacco consumption (Rasmussen, 2005), alcohol consumption (Bjork *et al*, 2006) and BMI (Groth *et al*, 2009) in Denmark and elsewhere (Barbeau *et al*, 2004; McLaren *et al*, 2007), as also confirmed in this study. A higher educational level was associated with decreases in smoking and BMI but with an increase in alcohol consumption. The latter finding may indicate that the study population included well-educated retired persons with adequate economic resources, who have been found to consume more alcohol in Denmark (Bjork *et al*, 2006).

An advantage of this study is its prospective design, which minimised recall bias. We used detailed registry-based information on cancer diagnoses and on marital status for a large population-based cohort. Furthermore, we strengthened our study by including separate analyses of a homogeneous group of men with PC and of men who quit smoking, decreased their BMI to normal weight or decreased their alcohol consumption to fewer than three drinks per day. Information on tobacco and alcohol consumption was based on self-reports; self-reported alcohol consumption accounts for 71% of sales in Denmark (Ekholm *et al*, 2008). The measures of alcohol consumption were slightly different in the baseline and follow-up questionnaires, which might have resulted in the reporting of more alcohol consumption at follow-up. Still, we have no reason to believe that underreporting of alcohol use would be different for men with and without cancer.

The alcohol consumption of the participants in this study was relatively high but similar to that of the general Danish population, in which the mean alcohol consumption of men increased from 1.5 to 2.1 drinks per day (25 g alcohol per day) in the period 1987–2003 (Bjork *et al*, 2006). During the period of this study, moderate alcohol intake was considered to protect against heart disease (Broholm, 2008), which might partly explain the high alcohol consumption found.

Weight and height were measured at baseline in the study centres by trained professionals, who calculated BMI. At follow-up, weight was self-reported, which might have resulted in underestimates. This assumption was confirmed in a validation study of the Diet Cancer and Health Study, which showed that self-reported mean weight was slightly underestimated (0.6 kg) among the 176 male participants (Bigaard *et al*, 2005).

In this study, the follow-up questionnaire was completed up to 5 years after cancer diagnosis. The results of separate analyses for men whose cancers were diagnosed within 2 years of follow-up and >2 years before follow-up may indicate that changes in tobacco consumption are continuous, whereas decreases in BMI occur close to the time of cancer diagnosis and may be a result of the disease and its treatment.

Although the men who were invited to participate in the Diet Cancer and Health Study were a random sample of the Danish population, the respondents differ from the general population, as married men with longer formal education were more likely to participate (Tjonneland *et al*, 2007), and they may represent a more health-conscious group. We were unable to control for potential confounders like physical activity, psychosocial factors and other environmental factors that may have caused changes in health behaviour. Further, as cancers were diagnosed throughout the follow-up period, the difference in time since cancer diagnosis might have affected the reporting of health behaviour; however, we conducted subanalyses of time since diagnosis to address this potential limitation. Thus, the results of this study should be generalised with care, and the findings should be interpreted with caution, as the changes in health behaviour might be due partly to changes in the measures.

Our findings nevertheless provide indications for clinicians about health behaviour changes made by male cancer survivors and might therefore be useful for planning their follow-up care. Checks for disease recurrence, late effects and psychosocial adjustment to the disease should be complemented by promotion of a healthy lifestyle.

In conclusion, this study found that, irrespective of cancer status, men significantly decrease their tobacco and alcohol consumption and BMI between baseline and follow-up. Men with cancer other than PC decreased their tobacco consumption and BMI significantly more than cancer-free men; however, the baseline levels of tobacco consumption were higher in men with cancer other than PC and then decreased to levels similar to those of cancer-free men. Still, men with cancer other than PC were more likely to quit smoking and decrease their BMI to normal weight compared with cancer-free men. These study findings should guide clinicians in planning follow-up care for cancer survivors. Future studies, with large samples, should assess health behaviour changes among men with cancers at sites other than the prostate.

ACKNOWLEDGEMENTS

This study was supported by the Danish Cancer Society.

Conflict of interest

The authors declare no conflict of interest.

Ethical approval

The Diet Cancer and Health study was approved by the regional ethical committees on human studies in Copenhagen and Aarhus and by the Danish Data Protection Agency.

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